FULMINATING MATERIAL APPLICATION TECHNIQUE

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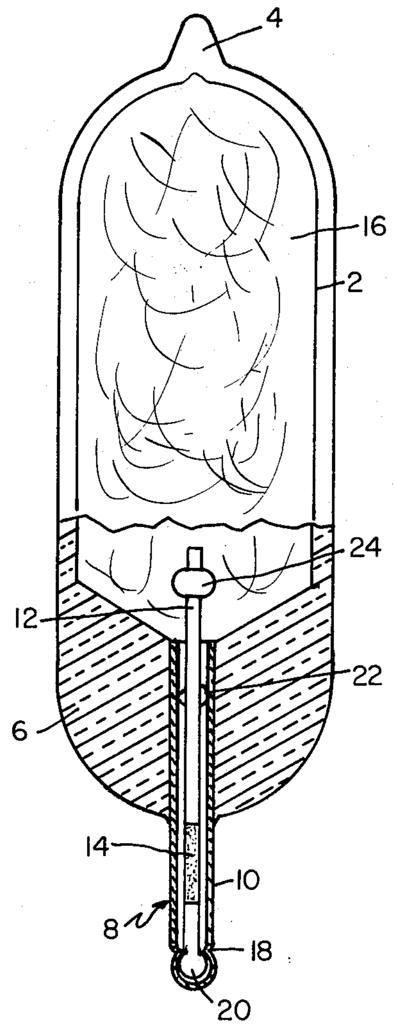

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FULMINATING MATERIAL APPLICATION TECHNIQUE

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ABSTRACT OF THE DISCLOSURE

A method of providing the primer anvil wire of a percussive-type photoflash lamp with a charge of a fulminating material in which a coating of fulminating material is applied on the anvil wire extending along its length a predetermined distance from one end thereof, the coating is dried, and then the coated end of the wire is dipped a predetermined distance into an electrolytic solution containing a colloidal thixotropic agent. This last step electrochemically strips the coating from a segment of the wire extending from the coated end thereof to thereby provide an anvil wire having a coating of fulminating material disposed on a segment of predetermined length located intermediate the ends thereof.

This invention relates to the manufacture of photoflash lamps and more particularly to those of the percussive type.

Generally speaking a percussive-type photoflash lamp comprises an hermetically sealed, light-transmitting envelope containing a source of actinic light and having a primer secured thereto. More particularly, the percussive-type photoflash lamp may comprise a length of glass tubing constricted to a tip at one end thereof and having a primer sealed therein at the other end thereof. The length of glass tubing which defines the lamp envelope contains a combustible such as shredded zirconium foil and a combustion-supporting gas such as oxygen. The primer comprises a metal tube and a charge of fulminating material on a wire anvil supported therein. Operation of the lamp is initiated by an impact onto the tube of the primer to cause deflagration of the fulminating material on the wire anvil up through the tube to ignite the combustible disposed in the lamp envelope.

The fulminating material generally comprises a mixture of red phosphorus, potassium chlorate (or sodium chlorate) and a powdered metal such as zirconium. It must be extremely sensitive to impact ignition to insure high lamp reliability of flashing with the desirably low impact energies delivered by the firing mechanism. At the same time, the metal tube of the primer is thin-walled and soft so as to minimize the required impact and afford maximum lamp reliability.

Relatively early in the development of a percussive-type photoflash lamp of the general type shown in the accompanying drawing, the primer comprised a metal tube closed at one end and a wire anvil having a coating of fulminating material located thereon at one end thereof. Initially, the coated wire anvil was just dropped into the tube and it bottomed on the closed end thereof. This arrangement was never entirely satisfactory for several reasons, including accidental ignition during insertion and poor firing reliability due to variations in the positioning and ultimate location of the body of fulminating material. Subsequently several improvements were made both in the construction of the primer and the composition of the fulminating material.

Ultimately, the wire anvil was provided with a head on the end thereof which bottoms in the primer tube and

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lobes intermediate the ends thereof, with the body of fulminating material located therebetween. Then when the anvil is placed in the tube with the head of the anvil bottoming in the closed end of the tube, the tube is crimped just above the head of the anvil thus positively anchoring it therein and the lobes stabilize the anvil within the tube.

The most practical means for applying fulminating material to the wire anvil in an automated production process is by dipping the anvil in a fluid slurry of the fulminating agent and then allowing it to dry. Such a dip process necessitates removal of the fulminating material from that part of the anvil where the crimp is located. This removal is best accomplished by an electrolytic washing process in which the tip of the coated anvil is dipped into an electrolyte surface. This electrolytic wash technique is based on the electrolysis of water, where hydrogen is released at the cathode and oxygen is released at the anode. The anvil wire is made the cathode and that portion of the surface to be cleaned of fulminating material is submerged into the electrolytic solution. The water based electrolyte penetrates the dry fulminating material and it appears that hydrogen bubbles are liberated between the surface of the anvil wire and the coating of fulminating material. This produces a high level of mechanical agitation which loosens the fulminating material from the surface of the anvil. The action takes place with such intensity that material is removed from the anvil surface in less than a second's time. This process can be carried out anodically. However, only half the volume of gas is released at the anode as compared to the cathode. Therefore, a certain amount of mechanical action is lost with anodic washing, and longer cleaning times or higher current levels are needed for removing fulminating material.

The electrolytic bath normally includes salt, alkaline cleaner and wetting agent. Although many ionic salts could be used as conduction promoting electrolytes, potassium chlorate previously was considered advantageous since it is a component of the fulminating material and its use in the electrolytic bath would inhibit leaching of the potassium chlorate from the fulminating material not to be removed during the electrolytic operation. Alkaline cleaners such as ammonium bicarbonate and trisodium phosphate were added to the solution to enhance the wetting and penetration of the fulminating material. The alkaline salts also improved electrolytic conductivity. It was also desirable to add organic surface active agents or detergents to the solution to improve the surface activity and penetration of the alkaline cleaner. However, a high concentration of wetting agent could cause foaming which would prevent a constant liquid level from being maintained. Accordingly, a trace of an anti-foaming agent was also considered useful in the electrolytic solution. Since heating the solution promotes more rapid removal of material, it is preferred to maintain a solution temperature of about 50° C.

Alternating or direct current may be used for the operation. However, direct current is desired, since alternating current reduces the evolution of hydrogen gas at the wire surface, and a corresponding amount of mechanical action is lost by its use. A rectified AC circuit can be used. Effective cleaning is obtained at voltage outputs of 1 volt or higher; 18 to 20 volts is preferred.

Reproducibility of the washoff operation in part determines the weight of fulminating material remaining on the anvil, and the weight of fulminating material present per lamp has a direct effect on the lamp timing and light output. Hence, variations in washoff can significantly affect light output characteristics from one lamp to another. Another detrimental effect of nonuniform washoff is a decrease in lamp flashing reliability that occurs when the removal of fulminating material extends up into the impact zone. Still another problem associated with a variable washoff process is ignition during the crimping operation when a sufficient quantity of fulminating material has not been removed. Those lamps with fulminating material near or under the crimp are very susceptible to accidental ignition triggered by vibration during handling, shipping, and use of the lamp.

In view of the criticality of the height of washoff, the surface uniformity of the electrolytic wash solution is quite significant. The maintenance of an even electrolyte surface becomes a substantial problem, however, when confronted with the machine vibrations and manipulations of an automated production process. For example, in one preferred mechanized arrangement, the anvil wire is suspended from a head and indexed from station to station. At the first station, a ladle containing a liquid suspension of fulminating material is raised to cause the end of the anvil wire with the formed bead to be dipped in the suspension a distance sufficient to coat the surface up to a point just below the lobes. The coating of fulminating material is then dried by indexing the anvil wire through a heating manifold. This sequence may then be repeated to apply a second coat of fulminating material on the anvil. The dried, coated anvil wire is then indexed over a ladle containing the electrolytic wash solution. This ladle is then raised to cause the coated wire to be dipped into the electrolyte a predetermined distance sufficient to electrolchemically strip the coating from a segment of the wire extending from the coated end thereof. Subsequently, the anvil wire is again dried by indexing through a heating manifold.

Such processing has been observed to cause a quivering or wave motion on the surface of the electrolyte which can result in some nonuniformity in the amount of fulminating material removed. Hence, although the electrochemical stripping process provides significant advantages over prior method of removing fulminating material, further improvement in accuracy and reproducibility are required in view of the extreme criticality of the lamp structure involved.

In view of the foregoing, a principal object of this invention is to promote increased reliability and light output uniformity of percussive flash lamps by providing and anvil coating method in which the accuracy and reproducibility of anvil washoff are significantly improved. Another object is to provide more controlled removal of fulminating material from the anvil tip and thereby reduce inadvertent ignitions of percussive flashlamps during manufacture and handling.

We have discovered that substantial improvement in washoff uniformity can be achieved, particularly on automated lamp manufacturing equipment, by incorporation of a colloidal thixotropic agent into the electrolytic wash solution. Such materials as colloidal silicon dioxide, aluminum oxide, and magnesium montmorillonite promote rapid damping action of the solution surface without causing other problems such as foaming.

An effective wash solution embodying the features of this invention is the following: magnesium montmorillonite, 0.5%; potassium chlorate, 7.5% and water, 92.0%. Potassium chlorate has been used as the electrolyte so as to prevent possible extraction of this compound from the fulminating material that remains on the anvil, and resulting desensitization. It has been found, however, that such extraction or contamination is not a problem since only the fulminating material that is removed comes in contact with the wash solution. Accordingly we prefer to use a safer, nonoxidizing salt of greater solubility than potassium chlorate. Such materials as potassium chloride and sodium sulfate promote improved washing action because of greater solubility and higher conductivity of the solutions. An example of a suitable wash solution of this type incorporating the features of this invention is: magnesium montmorillonite, 0.5%; sodium sulfate, 20.0%; and water, 79.5%. Such solutions give very rapid and complete removal of the fulminating material and are much safer in the event of spillage.

The weight percentage of thixotropic agent may be from 0.1% to 10% and depends upon the desired viscosity as well as the properties of the particular thixotropic agent used. The choice of salt to be used as the electrolyte is not critical. The salt should, however, be neutral, non-hygroscopic, and nondegrading toward red phosphorous. In particular, stable non-hygroscopic salts of the alkali metals are preferred. The concentration of salt used may vary from 3% by weight to the limit of solubility of the particular material used (26% for potassium chloride and about 30% for sodium sulfate, for example). Solution conductivity and speed of washoff are proportional to the salt concentration used. In addition to the salt and thixotropic agent, the solution may also include traces of an alkaline cleaner, a wetting agent and an anti-foaming material as previously discussed.

An example of a very satisfactory system using the principles of this invention is given below.

A coating of fulminating material is applied on the anvil wire extending therealong a predetermined distance from the one end thereof. This application technique may take various forms. For example, the anvil wire may be dipped one or more times into an aqueous slurry of a complete mixture of the fulminating material. Another technique is to first dip the anvil into an aqueous slurry of all ingredients of the fulminating material except the oxidizer; after drying, the coated wire is then dipped into an aqueous solution containing about 20% by weight of dissolved sodium chlorate. Upon drying, an impact sensitive fulminating material coating results.

After the fulminating material is dried, the coated end of the anvil wire is dipped a predetermined distance into an electrolytic solution of the type described above containing a colloidal thixotropic agent to dampen any wave action on the solution surface and thus enhance the uniformity of fulminating material washoff. This dip electrochemically strips the fulminating material coating from a segment of the anvil wire extending a predetermined distance from the coated end thereof.

In the accompanying drawing, the single figure is a sectional elevational view of a percussive-type photoflash lamp having a primer of the type with which the method of this invention may be employed. The lamp comprises a length of glass tubing defining an hermetically sealed lamp envelope **2** constricted at one end to define an exhaust tip **4** and shaped to define a seal **6** about a primer **8** at the other end thereof. The primer **8** comprises a metal tube **10**, a wire anvil **12** and a charge of fulminating material **14**. A combustible such as filamentary zirconium **16** and a combustion-supporting gas such as oxygen are disposed within the lamp envelope. The wire anvil **12** is centered within the tube **10** and held in place by a crimp **18** just above the head **20** of the anvil. Additional means, such as lobes **22** on wire anvil **12**, are also used to aid in stabilizing and supporting it substantially coaxial within the primer tube **10** and insuring clearance between the fulminating material **14** and the inside wall of the tube **10**. A refractory bead **24**, fused to the wire anvil **12** just above the inner mouth of the primer tube **10**, eliminates burnthroughs and functions as a deflector to deflect and control the ejection of hot particles of fulminating material from the primer tube.

The method of this invention, employing the use of colloidal thixotropic agents in the electrolytic wash solution, enhances the accuracy and uniformity of fulminating material washoff and thus the quality and performance of the resulting percussive flashlamps. The electrolyte surface control hereby provided is particularly useful in automatic, high speed percussive flashlamp production.

What we claim is:

1. The method of providing a primer anvil wire of a percussive-type photoflash lamp with a coating of fulminating material thereon intermediate the ends thereof, said method comprising:

applying a coating of fulminating material on said wire extending therealong a predetermined distance from one end thereof;

drying said coated wire;

and dipping the coated end of said wire a predetermined distance into an aqueous electrolytic solution containing a colloidal thixotropic agent to thereby electrochemically strip said coating from a segment of said coated wire extending a predetermined distance from the coated end thereof, the proportion of thixotropic agent in said solution being sufficient to dampen any wave action on the solution surface so as to enable accurate and uniform removal of said coating.

2. The method of claim 1 in which said electrolytic solution comprises a salt, a thixotropic agent and water.

3. The method of claim 2 in which said thixotropic agent is magnesium montmorillonite.

4. The method of claim 1 in which said electrolytic solution comprises about 0.5% magnesium montmorillonite, about 20% sodium sulfate, and about 79.5% water.

5. The method of claim 1 in which said electrolytic solution comprises a salt in an amount within the range of about 3% by weight of the solution to the limit of its solubility in water, a thixotropic agent in an amount within the range of about 0.1% to about 10% by weight

of the solution, and the remaining proportion of the solution essentially comprising water.

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